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Exxon Background Series

COASTAL ZONE  
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The offshore search  
for oil and gas

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## INTRODUCTION

The search for oil and gas to satisfy the world's growing energy demands has been moving offshore increasingly in recent years. This trend, plus widely publicized accounts of some blowouts and spills resulting from drilling and producing activities, has given rise to public concern about the possible impact on the offshore environment. In view of this concern and the much higher costs of offshore drilling as compared with onshore work, why does the petroleum industry persist in the offshore search for oil and gas? The reason is simple: that's where much of the remaining undiscovered petroleum is believed to be, and the world needs the energy.

Offshore drilling is not at all new. It has been going on for several decades and has resulted in the discovery of large quantities of oil. In 1974, offshore areas accounted for about 10 million barrels daily, or about 18 percent of the worldwide crude production of about 58 million barrels daily. Offshore proved crude oil reserves are estimated at 162 billion barrels and represent 23 percent of the world total. Offshore drilling in the United States began off California as early as the end of last century and has been widespread there and in the Gulf of Mexico for the past quarter of a century. To date, more than 19,000 wells have been drilled in U.S. waters.

Offshore activity overseas began later than in the United States, but exploration and drilling now is conducted in all corners of the globe, with extensive drilling in Lake Maracaibo in Venezuela, in the North Sea, off West

Africa and South America, in the Mediterranean, in Australian and Indonesian waters, and in the Persian Gulf—to name the principal areas. Wells have been or are being drilled in the waters of at least seventy countries—more than half the nations of the world—and petroleum is being produced offshore in at least thirty of these countries. Currently, more than 480 rigs are in operation around the world, drilling wells in waters as deep as 2,000 feet and at distances as far as 165 miles from shore.

Drilling offshore normally is more difficult and expensive than drilling wells onshore. While there is no greater assurance of success, there is more opportunity for finding large fields capable of significant production in the undrilled offshore basins than in the mature, well-drilled onshore producing areas.

## THE NEEDS

To understand fully the reasons for moving offshore, we must look at the energy supply-and-demand picture today.

World energy consumption rose about 80 percent between 1960 and 1973 and is still increasing. This growth in energy consumption is basic to the desire of the nations of the world to develop their economies and raise their living standards. While the bulk of the energy from oil is consumed today in the developed countries in North America and Europe, and in Japan, consumption is increasing in all parts of the world.

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The search for oil and gas is moving offshore increasingly.

Offshore production of 10 million barrels a day is about 18 percent of the world's crude oil total.

Wells have been drilled in waters of at least 70 countries, and production is occurring in about 30.

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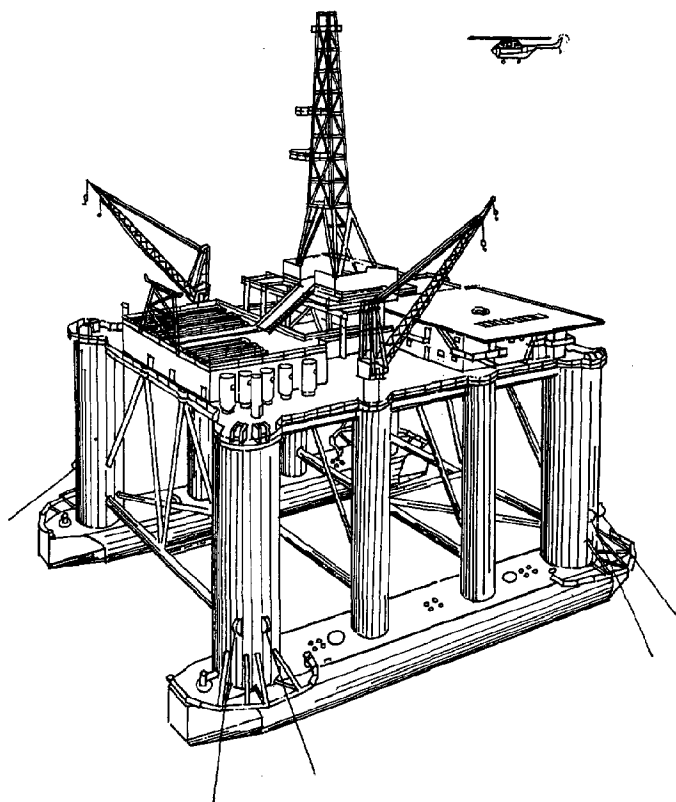
A glance at the world's estimated oil reserves shows that the Middle East towers above all other regions. Africa's reserves are put at 68 billion barrels; Central and South America have 41 billion barrels; the United States has 35, including an estimated 10 billion barrels in Alaska; Europe, 26 billion; Asia and Australia, 21 billion; Canada, 9 billion barrels. But the Middle East has 404 billion barrels of estimated reserves, something like two-thirds of all the estimated reserves in non-Communist countries. (Although definitive figures are difficult to obtain, the reserves of Communist nations have been estimated at 111 billion barrels.)

Much of these reserves—in fact, most of those in Europe, Asia, and Australia—are in offshore areas.

Obviously, most of the world will have to continue to depend upon the Middle East and North and West Africa for the greater part of its oil supply. The United States has been importing increasing quantities from those regions.

Only by major new discoveries in other areas of the world can that dependence be lessened. Oil and natural gas have become increasingly more difficult and costly to find on land. But offshore areas are estimated to have important potential reserves of oil and gas that as yet have been only partially tapped.

Naturally, the offshore search for oil and gas must be conducted with full regard for the environment. In this respect, the industry's record in offshore operations, particularly in U.S. waters, probably is better than is generally recognized. But the challenges are many and meeting them with minimum damage to the sea environment demands continuing efforts.



## THE DIFFICULTIES

One of the greatest handicaps of offshore drilling and production, of course, is the weather. To the usual outdoor challenges of wind, rain, snow, and ice are added tides, high waves, fog and in some locations, hurricanes, earthquakes, ice floes and icebergs. Not only can these hamper operations, but also they can threaten the safety of the workers and the survival of the equipment. Storms can come up quickly in some parts of the world and can bring winds of more than 100 miles an hour and waves 80 or more feet high. Equipment must be secured quickly, and in some cases crews must be evacuated to the safety of shore locations. Storms can force a halt in drilling, as well as in production activities and require extensive precautions against equipment damage and the threat of oil spills.

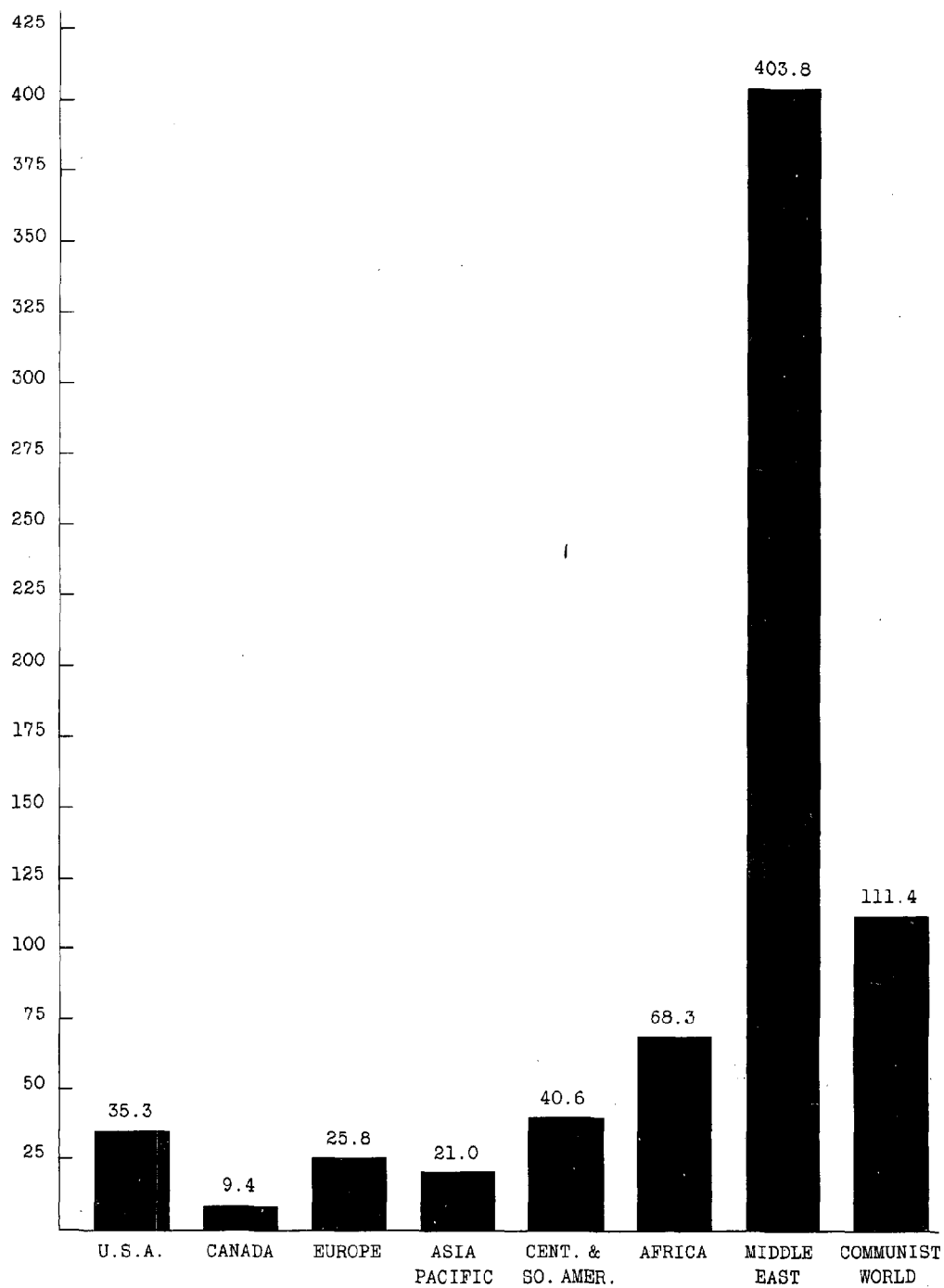
To the weather are added other natural difficulties of an offshore well site, particularly when it is in waters several hundred feet deep. A variety of rig types equipped with specialized and highly sophisticated equipment has been developed to meet the varied demands of offshore drilling. Delivering the supplies and transporting personnel to remote and physically hostile environments raise logistical challenges demanding the best in marine equipment and operations.

Offshore exploration and production are very expensive. Large amounts are paid by exploration companies to governments to secure offshore leases. Capital and operating expenditures for offshore oil exploration and production throughout the world are generally much greater than the expenditures required for exploration and production onshore.

The Joint Association Survey by the American Petroleum Institute and others in 1975 lists average drilling cost (1973) of a U.S. offshore exploration or production well as \$650,000, as compared with approximately \$98,000 for the average onshore well in the continental United States, although part of the higher cost of wells offshore is explained by their generally greater depth. Costs have risen since 1973.

*Once anchored in place, the semi-submersible is used to drill wildcat or exploratory wells in depths about 1,000 feet.*

WORLD'S ESTIMATED CRUDE OIL RESERVES  
BILLIONS OF BARRELS  
YEAR-END 1974



Source: Oil and Gas Journal, December 30, 1974.  
World total of 715.6 includes estimated 162 billion barrels offshore.

The cost of an exploration well in the North Sea is about four and one-half million dollars. A large production platform in the North Sea capable of having 35 to 45 wells costs from 175 to 200 million dollars. Completion of producing wells and transporting the oil or gas to shore also are costly.

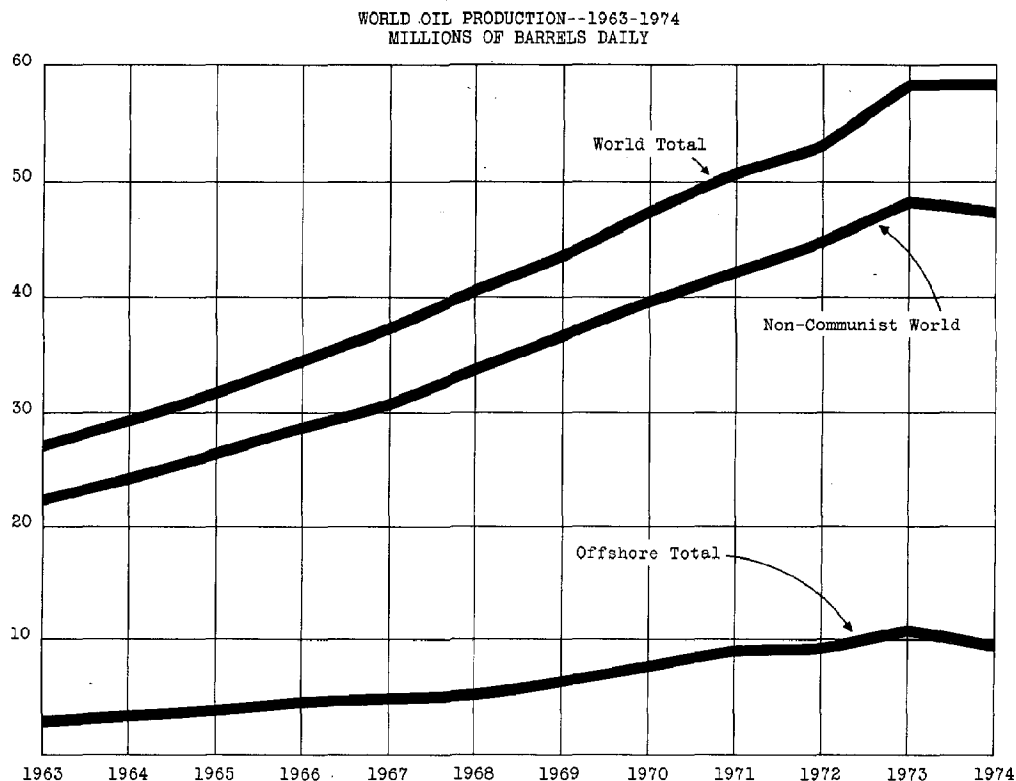
In 1970, a contractor's charge for an exploration drilling vessel operating in the North Sea and many other offshore areas of the world was 20 to 25 thousand dollars a day. This cost since, like that of many other materials, supplies and services, has more than doubled, and such vessels now cost oil companies 50 to 70 thousand dollars a day.

Thus, as the offshore share of total oil produced increases, the cost per barrel of oil is likely to rise.

An impediment to offshore exploration and production is the question of jurisdiction. The 1958 Convention on the Continental Shelf, to

which nearly fifty nations now subscribe, holds that coastal state jurisdiction over seabed resources extends at least to a depth of 200 meters (ca. 650 feet) and beyond to the limit that technology permits. But who is to exercise authority beyond the limits of coastal state jurisdiction? These and other complex legal and political issues facing offshore activities are yet to be resolved.

Little exploratory drilling has taken place beyond the 200-meter depth, and most offshore drilling for oil or gas has occurred at distances less than 100 miles offshore. Still, it is clear that the search is moving farther offshore and into deeper waters. Currently, exploratory permits are held for areas with water much deeper than 600 feet, and have been issued for areas with water as deep as 13,000 feet off eastern Canada.



Source: Industry Reports.

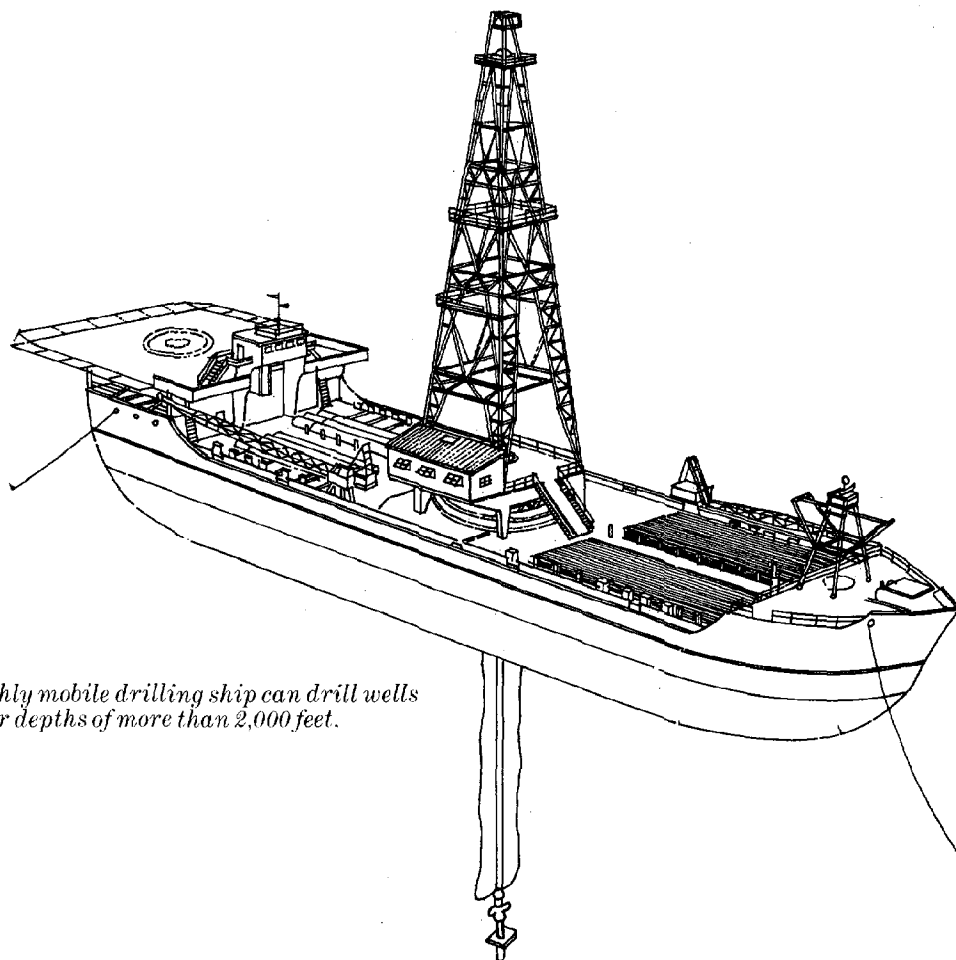
Note: Natural gas liquids, which comprise about 5 percent of each total, are included.

## THE SEARCH

The search for oil or gas offshore, as that on land, begins with seismic surveys, but with a special water technique that can cover a greater area in a shorter time. Sound waves are generated to travel downward deep below the seabed. These waves are reflected from successive rock formations back to the surface where they are picked up by detecting devices and recorded. By measuring the time intervals required for the impulses to travel down and back, and correcting and interpreting the data, a geophysicist can determine the general configuration of the formations that lie underground, and identify possible traps in which oil or gas might have accumulated.

A few years ago Exxon\* invented a device for this purpose to replace the use of dynamite in creating shock waves under water. A mixture of propane and oxygen is ignited inside a rubber sleeve. Rapid combustion inflates the sleeve like an instant balloon and produces a seismic pulse. The device is not injurious to marine life and is much more economical to use than dynamite.

\*The term Exxon as used in this publication refers not only to Exxon Corporation, but also to companies affiliated with Exxon Corporation.



*The highly mobile drilling ship can drill wells in water depths of more than 2,000 feet.*

## DRILLING OFFSHORE

If geophysical and geological data indicate that there's a possibility of finding oil or natural gas under the ocean floor, the next step is to drill an exploratory well. To do this, movable rigs are used. About 290 of these are at work today around the world, one-fourth of them in U.S. waters. Three general types of mobile rigs are used in exploratory drilling. One is the self-elevating rig which can be towed to the location. At the site, the legs are lowered to the seabed and the platform is jacked up to a safe level above the sea. The maximum water depth in which jack-up rigs are used is about 350 feet.

A second type of rig is known as semi-submersible. Some of these actually can sit on the bottom in shallow water, but they are more frequently used in a partially submerged position, moored by anchors, much like a ship. Mooring lines may extend a mile or more. At the end of each line is a massive anchor, weighing as much as 40,000 pounds. An elaborate acoustical system monitors the position of the rig in relation to the well. One of these rigs can displace as much as 40,000 tons and cost more than \$50 million to build. About 70 are in operation. Several semi-submersibles have drilled wells in water 600 feet deep, and semi-submersibles designed for depths of 2,000 to 3,500 feet are under construction.

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Weather and deep water bring major challenges to offshore operations.

Seismic surveys, one of the first steps in offshore exploration, are aided by a pulse device developed by Exxon.

More than half of the almost 500 rigs in operation offshore are mobile.

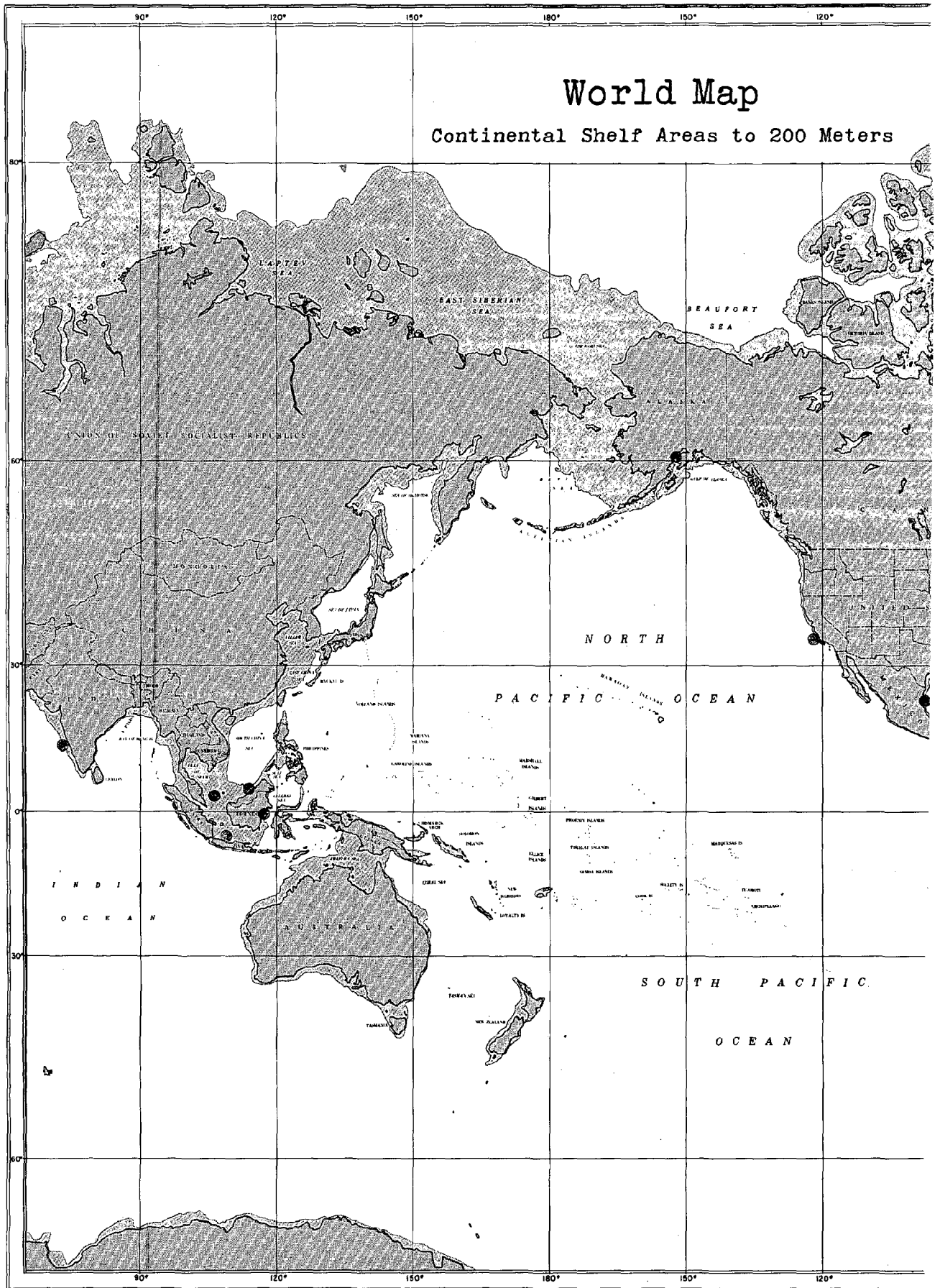
Wells have been drilled in water depths greater than 2,000 feet.

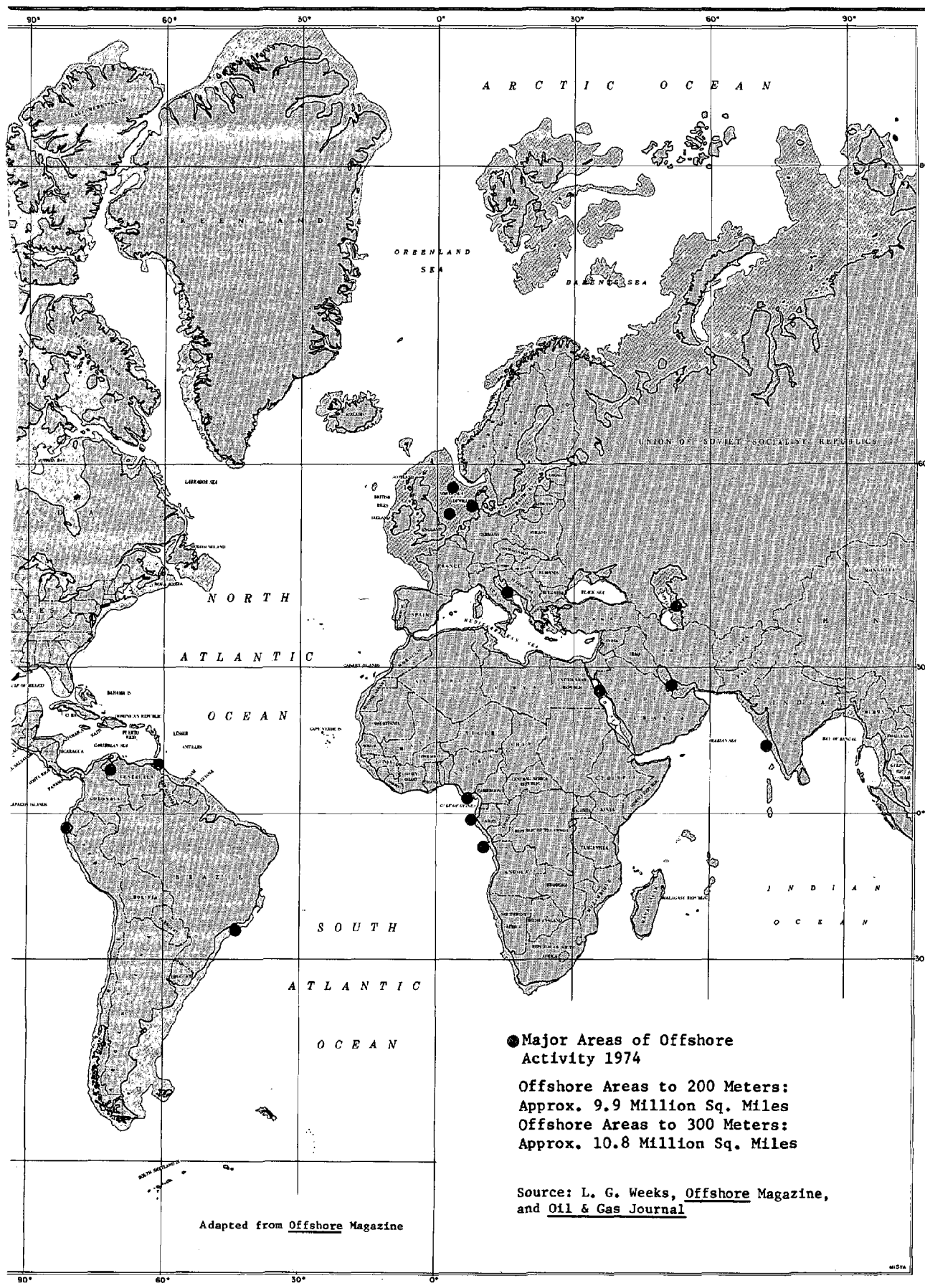
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Finally, there is the drill ship. This is a ship with a hole through the hull for drilling. It is usually moored in the same manner as a semi-submersible; however, drill ships and semi-submersibles designed for use in deep water supplement or replace the mooring system with thrusters. Drill ships have been used in water depths greater than 2,000 feet, and new ones under construction are designed for operations in water up to 6,000 feet deep.

Drilling an offshore well with these mobile rigs is in many respects like drilling on land, but it is more demanding and costly because of the environment. It is an around-the-clock operation. Elaborate guidance systems and blowout preventers installed on the ocean floor are combined with the latest drilling technologies to minimize the danger of blowouts and to assure safe and effective drilling. The blowout preventer is installed on the wellhead after the first string of casing is set in the hole. This important safety device can close off the space between the drill pipe and the casing in a matter of seconds if unexpected high pressures are met.

If exploratory drilling finds oil or gas in amounts that can be produced economically, permanent platforms are installed to drill development wells. These platforms are huge, fixed structures that can be installed in hundreds of feet of water. Like the mobile rigs, they are large enough to contain living quarters for the work crew, a helicopter landing pad, storage space for supplies, and room for the drilling and production equipment. The typical platform is so designed that thirty or more wells may be drilled from it by directional or angular drilling. Thus, wells drilled from a single platform may extend over several hundred acres as measured at the bottoms of the holes.





## TOWARD SAFER OPERATIONS

The design and construction of offshore structures are part of the petroleum industry's efforts to protect the ocean environment. Extensive studies have been made of the effect of water depths, tides, shifting currents and wave and wind forces during storms to ensure that offshore drilling and production platforms can withstand these elements.

The offshore structures now in use in deep waters of the Gulf of Mexico have been built to endure winds up to 140 miles an hour and waves of more than 60 feet. Platforms operating in the Cook Inlet of Alaska have withstood a special challenge—rafted ice floes six feet thick. During the winter these floes are carried in and out of the inlet by swift currents and thirty-foot tides. In the North Atlantic, operators must be on the alert for icebergs. Canadian companies have towed icebergs to keep them from drifting into floating drilling operations, and have used drill ships that stay on location, using thrusters instead of anchors, so that, after making the well safe, the ship can move out of the way quickly if an iceberg approaches too closely.

Most offshore producing wells are equipped with a sub-surface safety valve. The exceptions generally are wells with low-pressure flows deemed not to be hazardous. Installed in the well itself below the ocean floor, the valve is designed to shut down production automatically when there is a sudden release of well-head pressure or when the flow rate increases too rapidly. If a hurricane, for example, were to damage the normal producing system, the valve would close to stop the flow of oil or gas. Regular checks of these devices are made to assure proper functioning. New wells in U.S. waters are being equipped with an improved down-hole safety valve controlled from the surface. In areas where formation solids (usually sand) are produced along with the oil, another safety device, called an erosion probe, is used. This system senses sand production and closes in the well before the abrasive solids can cut through surface flowlines.

Despite all precautions, blowouts do occur occasionally. There are a number of ways to deal with a blowout, but the operator normally tries first to shut off the well with exist-

ing valves or other control equipment. If existing equipment cannot be used, replacement of control equipment may be tried. In some cases, a heavy casing with valves is lowered into place over the wellhead, and the flow of oil or gas continues through the valves. When the casing is securely fastened, the valves are closed one by one until the well is under control. These control methods sometimes can be carried out in a matter of a few hours. If for any reason the wellhead cannot be capped, the usual procedure is to drill a relief well. To do this, a rig is moved to a nearby spot and a hole is drilled at an angle until it comes close to the bottom of the blow-out well. When this is done, mud is pumped into the underground reservoir under high pressure, stopping the flow. This is a difficult and time-consuming procedure which can take several weeks.

Most important, of course, is prevention of blowouts or other accidents, and to that end Exxon established one of the world's first well-control schools. This unusual program is centered around a mile-deep well on the vast King Ranch in southern Texas. For the past seven years, drilling superintendents and contract crews from Exxon affiliates all over the world have attended sessions there to learn and practice the latest techniques in blowout prevention and control. Other companies now offer similar programs, and Louisiana State University, the University of Oklahoma, and the University of Southwest-

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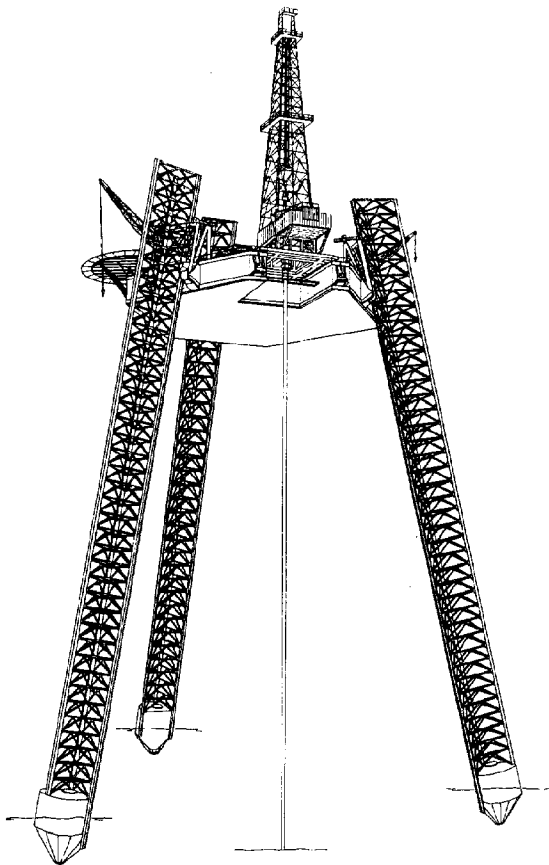
Huge, fixed platforms permit development drilling and production of more than 30 wells from a single structure.

Sub-surface safety valves are used to stop the flow in producing wells if there should be a mechanical malfunction.

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ern Louisiana conduct well-control training courses open to drilling personnel of the whole oil industry. Blowout prevention training programs are conducted in other countries, too. For example, Exxon conducts approximately ten seminars on blowout prevention each year for overseas affiliate and contractor personnel wherever Exxon is drilling for oil. The company also conducts seminars on the latest equipment and techniques of floating drilling.

In addition to its extensive training activities in blowout prevention, Exxon is conducting an industry-funded program to study the blowout preventer equipment commonly used in floating drilling. The object is to make this vital equipment even more effective.



*With elevator legs, the jack-up rig can be floated to location and then raised, or jacked up, to an appropriate height above water. This rig's utility normally is limited to water about 350 feet deep.*

## THE ACCIDENT RECORD

The U.S. National Academy of Sciences estimated in a study published in 1975\* that 80,000 metric tons of oil enters the oceans each year from offshore drilling and producing operations. This is less than 2 percent of the total of oil entering the oceans from all sources, including marine transportation, coastal refineries, municipal and industrial wastes, urban and river runoff, and natural oil seeps. Of the 80,000 tons from offshore operations, one-fourth is estimated to be from minor spills of 50 barrels or less, and from discharge of oil field brines during normal operations. The remaining 60,000 tons a year is lost into the water in spills of more than 50 barrels.

While blowouts have occurred, both in U.S. waters and abroad, they nevertheless have been rare. In U.S. waters, the oil industry has drilled more than 18,000 wells since 1948, and several thousand are in production. During this 26-year period, only four blowouts have posed any serious pollution threat, and only one of them resulted in serious pollution to the beaches. This was the Santa Barbara Channel blowout of January 1969, that spilled an estimated 75,000 barrels of crude oil into the water in ten days, and caused the death of many birds. As serious as this blowout was, investigations a year later by a research team from the University of Southern California found that the spill caused no apparent lasting damage to marine life or the beaches.

Since beginning a regular program of offshore operations in the United States 26 years ago, Exxon has drilled nearly 1,500 offshore wells. It now is producing oil from about 500 wells on offshore platforms. Throughout the company's operations, it has had no oil spills from well blowouts classified so large as "moderate"—i.e. 240 barrels or more.\*\*

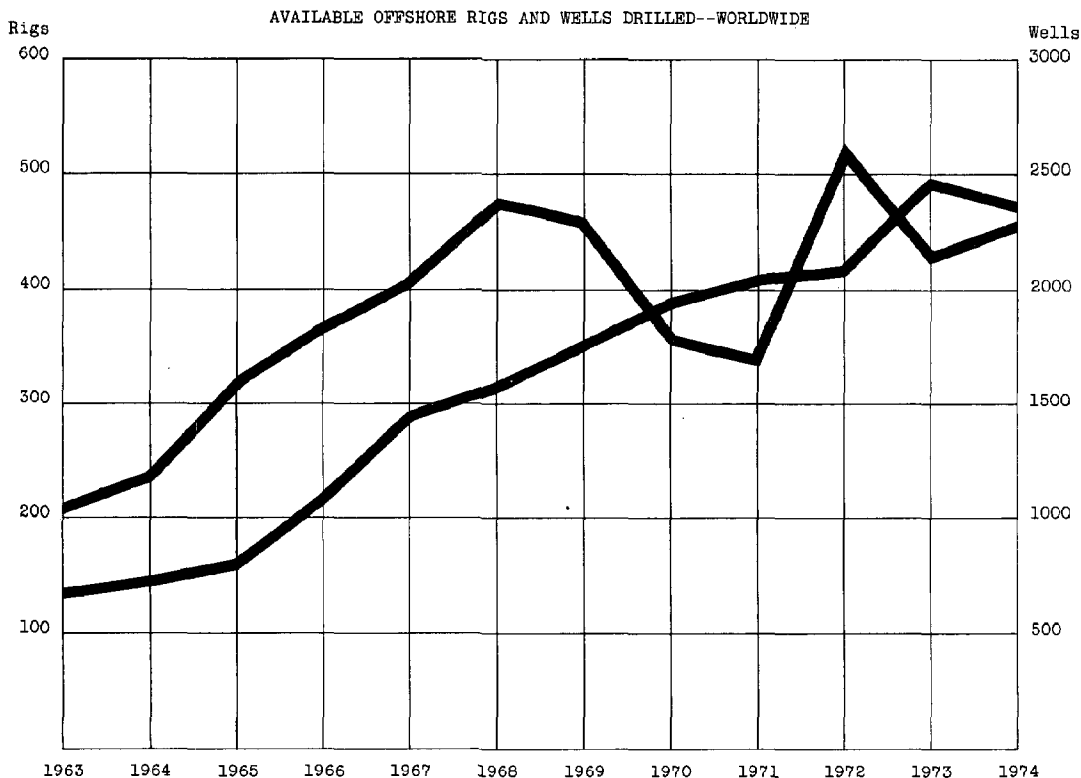
\*Petroleum in the Marine Environment, Washington, D.C. 1975.

\*\*U.S. authorities define a major spill as anything over 2,400 barrels; a moderate one is between 240 and 2,400 barrels; and a minor spill is one involving less than 240 barrels. The Water Quality Improvement Act of 1970 requires that all spills be reported to an appropriate U.S. government agency.

In the Gulf of Mexico, where the largest number of offshore rigs are in operation, the oil industry has experienced four serious blowouts and fires since December 1970, two of them requiring several weeks to bring under control. The largest blowout and fire in U.S. coastal waters occurred in December 1970, on Platform B in South Timbalier waters off Bay Marchand, Louisiana. Four men were killed and thirty-two injured in the blowout and fire that was not totally extinguished for more than four months. Immediately after the accident, the operating company mobilized a fleet of fire-fighting and pollution-control vessels and a force of 650 men to extinguish the blaze and contain the oil. Four rigs drilled ten relief wells into the producing formations of the burning wells before they were all "killed." Despite the massive control measures, it was not until April 1971 that the blowout was brought under control totally, although the main well had been killed within a month.

During 1973, the U.S. Coast Guard reported about 1,955 spill incidents at U.S. offshore production facilities, with a total release of about 20,000 barrels of oil into the marine environment (an average of about 11 barrels per spill). But there is little evidence of sustained damage to marine life, or significant or lasting pollution of the beaches.

Parenthetically, it is worth noting that at least one unanticipated benefit has resulted from offshore drilling production. Despite apprehensions about possible harmful effects on fishing grounds, the offshore platforms have proved attractive to the fish, which seem to be drawn to the underwater structures by the barnacles and other small marine life that cling to the beams, and waters around the platforms have become favorite spots for fishing.



Source: Offshore Magazine and Industry Reports.

## CONTAINING AND CLEANING SPILLS

Essential to the protection of the marine environment is the availability and use of containment and clean-up equipment. Several types of booms for containing the oil, and numerous skimmers and other recovery vessels for picking it up from the water have been developed by the industry and governments. The use of most of these in heavy seas is limited, but new equipment is being developed to operate more effectively in adverse weather and sea conditions. A "bottom tension" boom developed by Exxon is marketed by two manufacturers. This unit is designed to contain oil in waves as high as six feet and can withstand twenty-foot seas and fifty-knot winds. Increased availability of containment and clean-up equipment in drilling and production areas will help assure control and recovery of any oil spills.

Cooperatives such as Clean Seas, Inc. and Clean Gulf Associates have been established in the United States to provide such equipment for emergency clean-up of spills. Financed by Exxon and thirteen other oil companies operating in the Santa Barbara Channel, Clean Seas provides on a stand-by basis the equipment, materials, trained manpower, and technology to deal with spills. Clean Gulf, formed by 98 percent of the oil operators in the Gulf of Mexico, provides a similar capability for this area. Similar cooperative efforts for quick reaction to oil spill emergencies are under way in the North Sea and in other parts of the world.

The U.S. Coast Guard, too, has oil spill clean-up equipment available for rapid deployment from response centers at key locations. While intended for duty in U.S. waters, the Coast Guard Strike Teams have gained considerable experience on major foreign spills, among them tanker accidents in the Strait of Malacca and the Strait of Magellan.

Research on oil spills—both clean-up and prevention—continues on many fronts. Exxon, for example, has developed new low-toxicity chemicals for containment and dispersal of oil, as well as improved equipment for separating oil from water.

Exxon initiated a contract with Battelle-Northwest in 1970 to determine the long-range effects of oil spills on the sea and, in particular, on marine ecology. In 1971, the American Petroleum Institute (API) expanded this important effort at Battelle-Northwest as well as at other research institutions. In these studies, marine organisms of many different species were exposed to different crude oils and petroleum products. It was established that once an oil spill has passed, organisms cleanse themselves quickly of whatever oil contamination they may have incurred. Thus, these studies show that it is highly unlikely for such oil contamination to become concentrated by transfer through the food chain.

An Exxon affiliate in 1971 commissioned a two-year study by Battelle-Northwest of the impact of petroleum operations on the fishery resources on Lake Maracaibo. Analyses of environmental samples—water, sediments, and fish—showed low concentrations of oil in lake waters, and no detectable accumulation of petroleum-derived hydrocarbons in muscle tissue of selected commercial fish species. Natural processes of volatilization, biodegradation, and sedimentation were shown to be the major mechanisms by which oil is removed from the surface waters.

In a recently completed two-year environmental study in offshore Louisiana waters by the Gulf Universities Research Consortium, no significant environmental degradation was detected in this prolific oil-producing area.

## NEW TECHNOLOGY AND RESEARCH

Taking the search for petroleum and gas ever-farther offshore and into deeper waters requires both the extension of techniques used for many years in shallower waters and the development of new technology suitable for drilling in hundreds of feet of water.

A striking example of this is the system devised by Exxon to develop a major new field discovered in the Santa Barbara Channel under 700 to 1,500 feet of water. The wells will be in water two to four times deeper than any now in production in offshore areas. Significant finds of oil have been made in the western end of the channel, within a geological structure named the Five-Mile Trend because of its distance from shore. Development plans involve the use of deep-water platforms and submerged production systems.

The first drilling platform will be a real giant. Plans call for a towering eight-legged structure for a water depth of 850 feet, by far the tallest drilling platform in the history of the petroleum industry. The Santa Barbara structure has been designed not only to absorb pounding from storm waves, but also to withstand ground-shaking forces from a severe earthquake. (Another company has reserved construction yard space for two platforms suitable for 1,000 and 1,200-foot water depths for installation in the Gulf of Mexico. The prospect has not been drilled yet, however, and design work on the platforms is not complete.)

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Exxon is testing a prototype of the world's tallest drilling platform for installation in water 850 feet deep and Submerged Production System for use in depths beyond fixed platform capability.

A variety of containment and recovery systems has been developed, and cooperatives have been established to deal with spill emergencies.

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A "guyed tower," a new type of offshore platform for use in waters from 600 up to 2,000 feet deep, is being tested by Exxon in 1975, with a 370-foot model to be installed in 300 feet of water off the Louisiana coast. The test structure is a one-fifth scale model of an oil and gas platform designed for 1,500 feet of water. The platform is designed to sit on the ocean floor, held in place by bridge cables attached to anchors surrounding it. Such a guyed, or compliant, offshore tower (one which is allowed to "comply" or move with the waves) may offer an economically attractive alternative to conventional platforms or submerged systems for use in water depths from 600 to 2,000 feet.

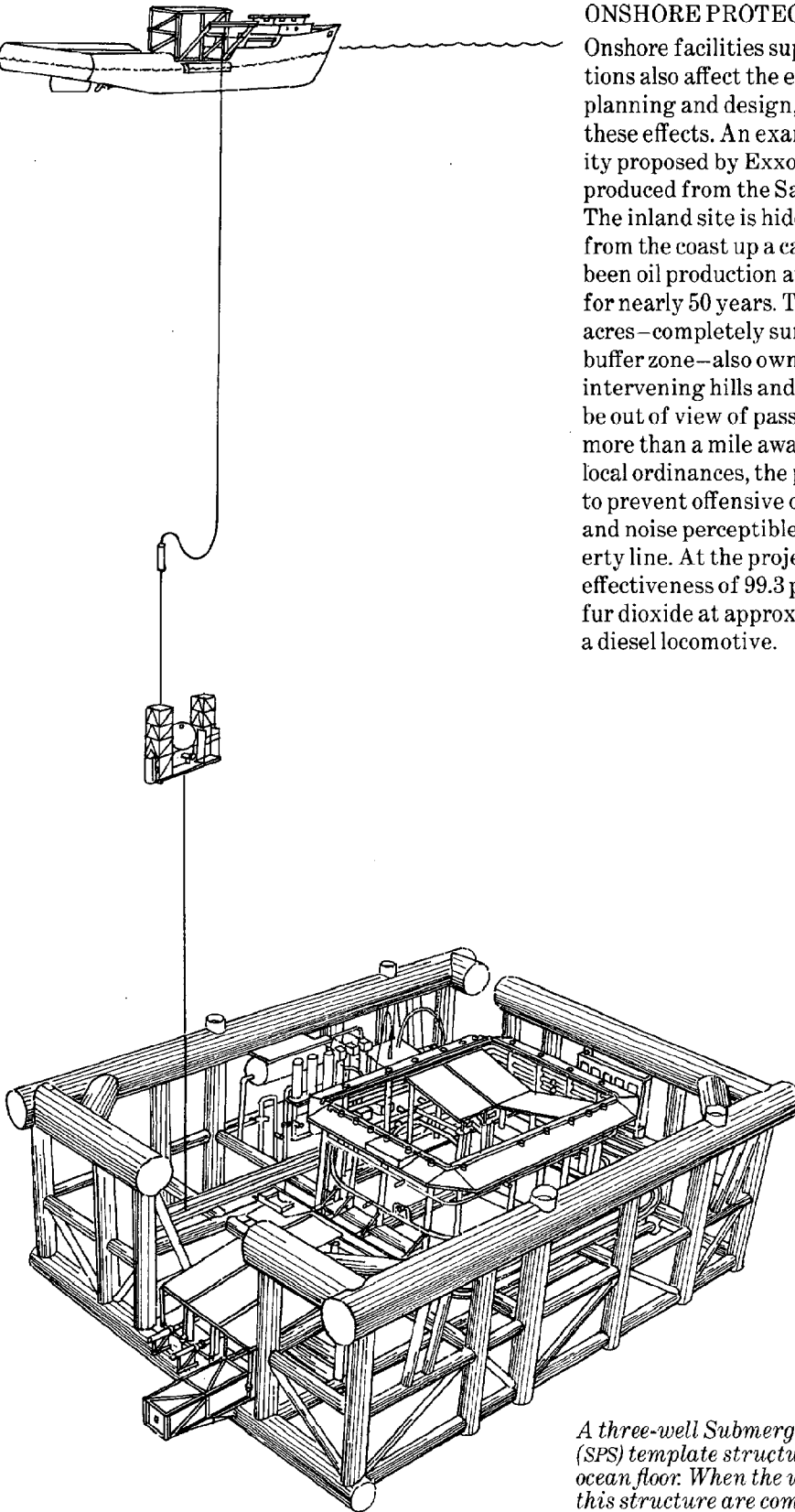
In order to produce oil or gas in water depths beyond that feasible for surface-piercing platforms, Exxon is developing a Submerged Production System, or SPS. This installation consists of a number of underwater wells completed in a cluster. The wells are drilled directionally from a floating rig through the template structure of the SPS, which is secured to the ocean floor. When they are ready for production, the subsea wells will be connected to the SPS manifold, and the oil from them will flow through pipelines to a surface facility.

The day-by-day operation of each SPS will involve advanced technology, including electronics to monitor and "instruct" the unit, hydraulics to open and close valves, and safety devices designed to isolate malfunctions. In the unlikely event that a leak does occur, oil-catching drip pans will collect the escaping oil. Simultaneously, an electronic sensor will activate a safety device, closing down the wells and valves in that part of the manifold where the trouble lies.

After extensive testing on land, a full-scale three-well SPS prototype is being tested in an offshore oil field in the Gulf of Mexico 65 miles southeast of New Orleans. Production from three SPS wells will be routed to a nearby platform in the same field. Although the prototype is installed in only 170 feet of water, the SPS is designed for use in water depths up to 2,000 feet. Research is now under way to extend the SPS capability to even greater depths.

## ONSHORE PROTECTION

Onshore facilities supporting offshore operations also affect the environment. Proper planning and design, however, can minimize these effects. An example is the onshore facility proposed by Exxon to treat the oil and gas produced from the Santa Barbara Channel. The inland site is hidden more than a mile from the coast up a canyon where there have been oil production and treatment facilities for nearly 50 years. The chosen plant site is 15 acres—completely surrounded by a 1,500 acre buffer zone—also owned by Exxon. Because of intervening hills and shrubbery, the plant will be out of view of passersby on the freeway more than a mile away. In compliance with local ordinances, the plant has been designed to prevent offensive or disturbing emissions and noise perceptible beyond Exxon's property line. At the projected sulphur removal effectiveness of 99.3 percent, it will emit sulfur dioxide at approximately the same rate as a diesel locomotive.

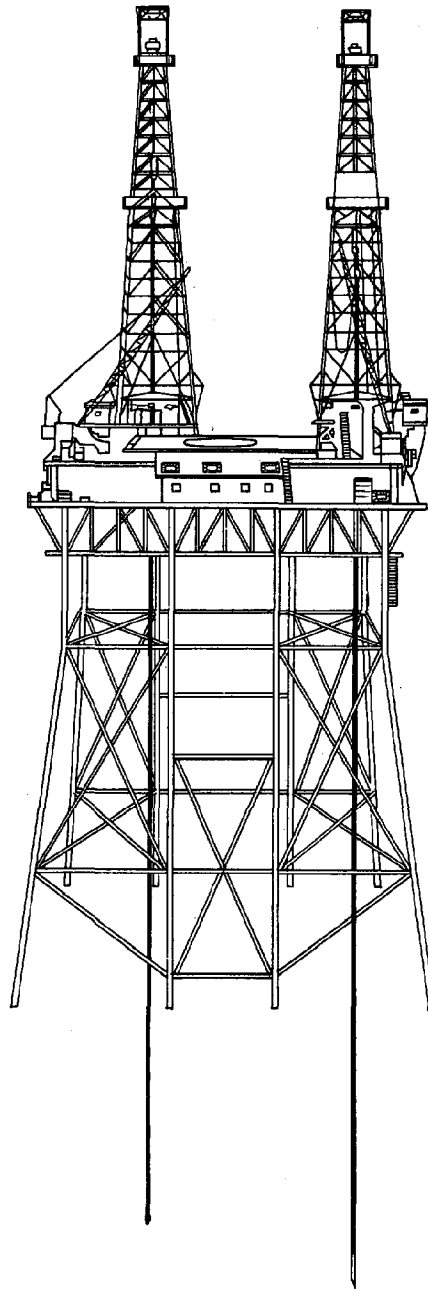


*A three-well Submerged Production System (SPS) template structure to be secured on the ocean floor. When the wells drilled through this structure are completed, they will be connected to the SPS manifold, and the oil will flow through pipelines to the shore.*

## SUMMARY

The coastal nations of the world recognize that their offshore areas can contribute to the energy that they and the rest of the world require if their economic development is to move ahead.

The ecology of the sea and that of the entire ecosphere must be protected in the process. The petroleum industry believes it can be done. It can demonstrate to a concerned public that it possesses practical and effective answers both to supplying the required energy and to preserving the natural environment. The record of offshore drilling and production is not perfect, but it is respectable, and with increased efforts in the future to operate more effectively and safely, the record can be improved and the quality of life preserved.



*Rigs mounted on fixed platforms, used for development drilling after an oil or gas discovery, permit drilling thirty or more wells from a single platform and location. After drilling, the rigs are removed, and the platform is used for production.*

